and the steam consumption (C) per hour, per horse-power, is given by

$$C = \frac{3600W}{J\eta_i} = \frac{2546}{J\eta_i},$$

The phrase " the steam consumption " means the consumption of steam per horse-power, per hour (briefly per horse-power-hour).

Conversely, if the steam consumption C of the turbine be measured, the efficiency is at once given by

$$\eta = \frac{CH'}{\sim}$$

In considering more fully the factors which influence the over-all efficiency of a turbine, it is necessary to examine the various inherent losses of energy which occur.

Internal Losses due to Steam Friction.—During the passage of the steam through the nozzle and blade passages which constitute the working elements of a turbine, frictional losses necessarily occur, and in all cases (excepting machines of the smallest output) these constitute the main losses in a steam turbine.

A secondary loss also occurs due to steam friction on the moving surfaces of the discs or rotors.

Internal Leakage Losses.—In the multi-stage turbine a certain proportion of the steam escapes from stage to stage without performing useful work. In the case of the impulse turbine this leakage mainly occurs at the glands where the shaft passes through the diaphragms. In the reaction turbine the leakage space occurs at the tips of the fixed and moving blades.

External Leakage Losses.—At the main glands where the rotor shaft passes through the main casing of the turbine a small leakage of steam occurs. At the high-pressure end of the turbine a certain amount of steam leaks outwards, and at the exhaust end, where the internal pressure is below atmospheric pressure, a quantity of live steam must be supplied to pack the gland and so prevent air being sucked into the condenser.

Radiation Losses.—Owing to the high temperature of the turbine casing, a certain amount of heat is lost to the surrounding atmosphere by radiation, but in a modern turbine of comparatively large output, if the

casing be well covered with some form of insulating material, the radiation loss is almost negligible.

External Mechanical Losses.—From the gross horse-power generated by the turbine the frictional losses which occur in the bearings and thrust block must be deducted. Also a small amount of power is absorbed by the oil-pump which supplies the bearings, &c., and by the driving of the necessary governing mechanism. The sum of all the external mechanical losses in the usual design of turbines may represent from i to 3 per cent according to the size of machine, and this indicates the difference between the gross horse-power developed by the turbine and the net power delivered at the coupling.